

1 Kiosk technology kit

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3 This invention relates to computer systems, in
4 particular, interfacing personal computers (PCs) to
5 peripherals in a multi-media kiosk applications.

6

7 In an embedded environment such as a kiosk, a PC needs to
8 be configured and supported with additional hardware to
9 provide system reliability and robustness and multiple
10 device interfaces.

11

12 In the prior art systems are known for embedding standard
13 PC hardware within a kiosk application. Such a system is
14 provided by Coyne UK Limited that uses hardware
15 containing an embedded processor on a control circuit
16 board programmed to influence the PC in a kiosk
17 application. During initialisation of the PC, or if the
18 PC control program is not in operation, the processor
19 automatically detects potential vulnerability in the
20 system and automatically takes steps to prevent use of
21 this system until it is once more stable and secure.

22

1 A significant problem with this and other known prior art
2 solutions to is the inefficient use of input/output (I/O)
3 ports of the PC. I/O ports such as serial RS-232 ports
4 are needed for communication with kiosk peripherals such
5 as coin mechanisms, note readers, meters for counting,
6 card readers and printers.

7
8 Even more ports, including RS-232 and motherboard
9 expansion slots (e.g. PCI, Peripheral Component
10 Interconnect) are needed for hardware used to monitor the
11 health and security of the PC, for example, controlling
12 the power supply and monitoring the software and hardware
13 state of the PC. An uninterruptable power supply (UPS) is
14 desirable for monitoring and control of power to the
15 motherboard and this is typically monitored and
16 controlled by the motherboard itself using an RS-232
17 port. A watchdog capability is useful to monitor the
18 state of the PC and this typically requires a processor
19 unit (e.g. a microcontroller) external to the motherboard
20 connected to the motherboard via a RS-232 port and other
21 connectors on the motherboard. In a kiosk system it is
22 desirable to have digital Digital Input/Output (DIO), and
23 this typically is achieved by using a PCI slot on the
24 motherboard with a DIO card or by having an RS-232 port
25 connection to a DIO device. An embedded system can be
26 further improved with the ability to store customer
27 specific data in non-volatile memory in order to provide
28 security features, and this is typically achieved with
29 the use of a PCI slot, an RS-232 port or a parallel port.
30 Another desirable features is output to an amplifier and
31 speaker which is typically done through a PCI slot with a
32 sound card. Communication with other processor such as
33 using the I²C (Inter-IC) bus would typically use another

1 PCI slot the motherboard for a communications adapter
2 card. The I²C bus is a standard two-wire serial bus used
3 in a variety of microcontroller-based embedded
4 applications for control, diagnostics and power
5 management. Yet another feature possible in an embedded
6 system is monitoring of the state of batteries connected
7 to the uninterruptable power supply, and this could be
8 achieved using hardware connected to another port of the
9 PC.

10

11 It can be seen that there are not enough ports on a
12 standard PC motherboard to supply all of the connectivity
13 to kiosks peripherals and for all of the desirable
14 functions listed above. The conventional approach to
15 this problem is to provide port expansion hardware,
16 typically occupying a PCI slot with a bank of UARTs
17 (Universal Asynchronous Receiver/Transmitters) controlled
18 by a microcontroller. The problem with this approach is
19 the cost and the complexity of software event handlers
20 needed to control all of the peripherals attached via the
21 bank of UARTs. It is not possible with this approach to
22 use a standard plug and play architecture for added
23 applications on the host PC because special event handler
24 code needs to be written at the microcontroller level or
25 a special abstraction layer and API (Application
26 Programming Interface) needs to be developed.

27

28 It would be advantageous to provide an architecture and a
29 control module that fulfilled all of the desirable
30 peripheral connection needs and all of the control
31 functions for a PC in an embedded application such as a
32 kiosk.

33

1 It is an object of the present invention to provide a
2 control module and architecture that occupies one
3 expansion slot on a PC motherboard while providing a
4 plurality of functions and ports needed for embedding a
5 motherboard in a kiosk application environment.
6

7 According to a first aspect of the present invention,
8 there is provided a control module comprising:

9 a motherboard bus connector for communication with a
10 motherboard;
11 a motherboard bus to serial port bridge module;
12 at least one serial port connector; and
13 a processor module.
14

15 Preferably the control module is adapted to provide at
16 least one peripheral control port for said motherboard.
17

18 Preferably the processor module comprises a monitoring
19 means for monitoring the state of said motherboard.
20

21 Typically, the monitoring means further monitors the
22 state of software running on said motherboard.
23

24 Preferably the processor module has a battery power
25 supply separate from the PC power supply.
26

27 Preferably processor module further comprises a power
28 supply monitoring means for monitoring the state of a
29 power supply supplying said motherboard.
30

31 According to a second aspect of the present invention,
32 there is provided a system comprising a motherboard and
33 the control module in accordance with the first aspect.

1

2 Preferably the system further comprises a socket server
3 means for providing event handlers for at least one
4 serial port corresponding to said at least one serial
5 port connector and operating substantially in between the
6 application layer and the operating system layer of the
7 software executing on the motherboard.

8

9 More preferably, the system further comprises a socket
10 server means for providing event handlers for said at
11 least one peripheral control port and operating
12 substantially in between the application layer and the
13 operating system layer of the software executing on the
14 motherboard.

15

16 Preferably, the system further comprises a battery, a
17 power supply and a battery management circuit wherein an
18 electrical connection between said battery and said power
19 supply is diverted through said battery management
20 circuit and said battery management circuit is controlled
21 by said processor module.

22

23 In order to provide a better understanding of the present
24 invention, an embodiment will now be described by way of
25 example only and with reference to the accompanying
26 figures in which:

27

28 - Figure 1 illustrates in schematic form a control
29 module in accordance with the present invention;

30

31 - Figure 2 illustrates in schematic form a software
32 architecture in accordance with the present
33 invention; and

1

2 - Figure 3 illustrates in schematic form a system
3 including a control module, a peripheral interface
4 module and peripherals in accordance with the
5 present invention.

6 - Figure 4 illustrates in schematic form a power
7 supply system in accordance with the present
8 invention.

9

10 The invention is a card for connecting to a PC
11 motherboard that functions to provide serial port
12 expansion, digital I/O port (DIO) expansion and control
13 functions for a PC in an embedded environment.

14

15 With reference to Figure 1, the control module 10 is
16 shown comprising a PCI connector 11, a PCI/RS-232 bridge
17 chip 12 comprising four UARTs with output to a single
18 multifunction connector 13 that includes three RS-232
19 ports 14 and two eight-bit DIO ports 15.

20

21 One RS-232 port from the bridge chip is connected to a
22 processor module which is a microcontroller unit 16 that
23 includes FLASH EEPROM memory 17 and boot loader ROM 18.

24

25 A Dallas iButton 19 from Dallas Semiconductor Corp. is
26 provided for measuring temperature, providing further
27 non-volatile memory (EEPROM), a real time clock and a
28 unique serial number. The serial number is used for
29 provision of security features, including software
30 licence verification, thus acting as a 'dongle'.

31

32 A power supply controller circuit 110 and connection 111
33 to the host motherboard's power supply unit is provided.

1 The microcontroller has its own back-up battery supply
2 115. An amplifier driver 112 for a speaker 113 and an I²C
3 Bus interface 114 are also provided.

4.

5 A motherboard interface 116 has a connector 117 for a
6 cable to the motherboard reset and power on pins.

7

8 The microcontroller performs a number of key tasks and
9 communicates with the host motherboard via the PCI slot.

10 The full utilisation of the microcontroller requires
11 installation of a socket server layer (described below
12 with reference to Figure 2) and a power control API on the
13 host system.

14

15 The microcontroller provides management of the power
16 system including the UPS and provides automatic shutdown
17 of the system after a preset period of AC (alternating
18 current) power loss. This is set to 3 minutes normally.
19 In addition, some motherboard / operating system
20 combinations can behave differently with respect to AC
21 power loss and restart conditions. The microcontroller is
22 programmed to automatically restart the system after
23 power restoration and deal with any issues related to
24 ACPM/BIOS (Advanced Configuration and Power Management /
25 Basic Input/Output System).

26

27 If the host system hangs, there may be now no way to
28 recover the system other than a full hardware reboot. The
29 microcontroller can detect when the system hangs and
30 automatically reboot. This can be programmed to cycle a
31 number of times to try to recover the system. Reboot
32 status is held within the microcontroller or iButton
33 EEPROM.

1
2 The microcontroller or iButton EEPROM stores factory set-
3 up data to aid situations where remote management is
4 being used or for a quick status inspection in the field.

5
6 A 2x16 character LCD (Liquid Crystal Display) can be
7 fitted to the control module to display system
8 information. Factory device identity and local error
9 codes can be displayed to provide assistance in
10 diagnosing field problems.

11
12 The microcontroller is connected to the multifunction
13 connector to provide a number of DIO ports for control
14 applications. The DIO control lines are configured as
15 inputs and outputs for system interfacing and control.
16 All lines are fully buffered to TTL (Transistor-
17 Transistor Logic) (5V) level. Examples of input signals
18 are alarm state, paper low and interlocks. Examples of
19 output signals are coin light and alarm reset. All output
20 control lines are taken via a buffer and can sink/source
21 200mA. A suitable external buffer device would be
22 required to control larger currents.

23
24 With reference to Figure 2 a software architecture 20
25 according to the present invention is shown
26 schematically. A serial port driver 21 connects to
27 serial ports 22. The operating system layer 23 contains
28 sockets 24, which are interfaced via a software protocol
29 to a socket server layer 25. The serial event handlers
30 are a module 26 in the socket server layer. This
31 provides an advantage over the prior art where serial
32 event handlers are written in the firmware of a
33 microcontroller unit in a serial port expansion module

1 along with several costly UARTs. Finally, the
2 application layer 27 is on top of the socket server
3 layer.

4
5 In order to provide system integrators with a simple
6 means of controlling peripherals, the socket server layer
7 is provided as a run-time device manager based on a
8 Windows™ sockets interface. An additional ActiveX™
9 component is also provided which, when combined with the
10 socket server layer allows device control directly from
11 HTML (HyperText Markup Language) and Java™ script. This
12 considerably reduces the complexity of application
13 development, allowing simple scripting to be used to
14 control all devices.

15
16 With reference to Figure 3 there is a PC 30 containing a
17 controller module according to the present invention
18 connected by a ribbon cable 31 (from the connector 13 of
19 Figure 1) to a peripheral interface module 32. This
20 Figure demonstrates how the controller module can be used
21 to embed a PC in a kiosk application. A large number of
22 peripherals 33 are connected to the PC using its own
23 ports, the ports of the controller module and through the
24 connectors of the peripheral interface module.

25
26 The motherboard is a standard micro-ATX (Advanced
27 Technology eXtended) form factor PC mainboard. Compared
28 to standard ATX, it enables smaller, cost-reduced system
29 designs. For example, the mainboard square area is
30 reduced to approx. 92 square inches. It typically
31 contains integrated graphics and audio, 2 DIMMs (Dual In
32 line Memory Modules) and a maximum of 3 PCI slots.

33

1 With reference to Figure 4 there is a power supply 40 for
2 embedding within the kiosk environment. The control
3 module contains a connection 41 to a battery management
4 circuit 42. The UPS 43 is a BiUPS® (Built-In UPS) from
5 Magnum Power Solutions Limited, which has output control
6 signals 44, a NiCd back-up battery 45 and an AC
7 (alternating current) input 46. It provides the host
8 computer system power distribution board 47 with embedded
9 un-interruptible protection of the UPS power output 48.
10 It occupies the same mechanical outline as an internal
11 switched-mode power supply.

12

13 The degree of protection depends on the capacity of the
14 back-up battery. The standard BiUPS system has two states
15 for the charging of the back-up battery: fast and trickle
16 charge. The problem with this is that the NiCd battery is
17 not optimally conditioned. In this embodiment, the system
18 is improved by diverting the electrical connection 49 of
19 the NiCd battery to the BiUPS power supply through a
20 battery management circuit that is controlled by the
21 microcontroller. This battery management function,
22 combined with the other power supply control signals
23 between the power supply and the microcontroller, allow
24 the monitoring and control of the optimum charging
25 conditions of the back-up battery.

26

27 Further modifications and improvements may be added
28 without departing from the scope of the invention herein
29 described